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Caffeine and Theobromine in Beverages

BY LESTER HANKIN
AND LUCIA McLEAN

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BY LESTER HANKIN
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Caffeine, 1,3,7-trimethylxanthine, which occurs naturally in tea leaves, coffee beans, cacao beans, and kola nuts, is one of the most widely consumed substances. About 7 million kilograms (over 15 million pounds) are consumed annually in the United States as an ingredient in coffee, tea, soft drinks, and prescription and nonprescription drugs (5). It is a mild stimulant and can be addictive (4). Theobromine, 3,7-dimethylxanthine, another stimulant, is the principal alkaloid of cacao beans but is also present in tea leaves (4). Many consumers have turned to decaffeinated coffee and tea and non-caffeinated soft drinks. The consumption of decaffeinated coffee, for example, has increased from 4 to 17% of the total coffee consumed in the past 25 years (5).

Code of Federal Regulations (CFR) lists caffeine as a substance "generally recognized as safe" but limits the amount which may be added to a food product to 0.02% (3). Soda water designated by any name which indicates "cola" or "pepper" shall contain caffeine but the total amount shall not exceed 0.02% by weight. All products must conform to FDA labeling (3).

This survey of caffeine and theobromine in beverages was made to provide information about the amounts of these compounds in various products. Consumers may then compare the caffeine and theobromine content among brands.

METHODS

Products were collected at food stores in Connecticut by inspectors of the Food Division of the Connecticut Department of Consumer Protection from December 1986 to March 1987.

Caffeine and theobromine were determined by High Performance Liquid Chromatography (HPLC). The instrument was a LDC Liquid Chromatograph with a ConstraMetric II G pump, SpectroMonitor III variable wavelength UV detector and a W-Porex C18 column. The mobile phase was water:acetonitrile (90:10 v/v). Beta-hydroxyethyltheophylline was used as the internal standard. Caffeine and theobromine were measured at 280 nm. Detection and extraction methods were adapted from Ashoor et al. (1) and Blauch and Tarka (2).

Sodas were tested for caffeine by diluting 5 milliliters (ml) to 100 ml with distilled water.

Ground coffees were brewed with distilled water in six-cup batches according to the label in a 10-cup Norelco Drip Filter Coffee Maker. Instant coffees were made by mixing 0.5 grams (g) in 100 ml hot distilled water.

Iced tea mixes were tested for caffeine and theobromine by mixing 1.0 g of product in 200 ml distilled water. Tea was prepared from regular tea bags by placing a tea bag in 100 ml boiling distilled water and steeping for 5 minutes. After steeping, the tea bag was drained for 30 seconds.

Tea from decaffeinated tea bags was prepared the same as for regular tea bags except that after steeping and cooling 25 ml were extracted with 3-50 ml of chloroform. The chloroform extracts were combined, evaporated to dryness on a rotary evaporator, and the residue was dissolved in distilled water.

Products were prepared and analyzed in duplicate. Results were averaged.

All results were calculated to milligrams caffeine or theobromine per 6 oz serving (177 ml). A zero value indicates <0.005 mg caffeine and <0.002 mg theobromine per 6 oz.

RESULTS AND DISCUSSION

The 121 products tested are listed in Tables 1 and 2. Following the brand are pertinent label designations and amount of caffeine and/or theobromine found per 6 oz serving.

For the 14 of the 34 cola type beverages containing caffeine the range was from 4.2 to 33.6 milligrams (mg) per 6 oz (Table 1). The average was 19.9 mg. Thirteen others designated cola did not contain caffeine. None of the seven caffeine-free colas contained caffeine. Three non-cola beverages contained caffeine. Two were prepared tea beverages and one contained coffee extract.

Twelve each of regular and decaffeinated ground coffees were tested. Coffee made from the decaffeinated coffees averaged 2.2 mg while that made from the regular coffee averaged 86.6 mg per 6 oz. Thus coffee made from decaffeinated ground coffee averaged about 97.5% less caffeine per 6 oz than that made from regular ground coffee.

Coffee made from the six instant coffees labeled as decaffeinated averaged 2.2 mg caffeine per 6 oz. Coffee prepared from the 11 regular instant coffees averaged 56.2 mg with a range from 22.9 to 66.3 mg. Thus coffee made from decaffeinated instant coffee contained on the average about 96% less caffeine per 6 oz than that made from regular instant coffee. Coffee made from two special instant coffees contained amounts of caffeine close to that from regular instant coffee.

Quantities of caffeine per 6 oz of tea made from regular iced tea mix averaged 17.2 mg and ranged from 4.4 to 25.1 mg (Table 2). The amount of caffeine in such mixes depends on the amount of tea extract used. Tea made from decaffeinated iced tea and fruit tea mixes contained 2.2 mg or less caffeine per 6 oz.

Tea made from decaffeinated tea bags contained about 86% less caffeine than tea made from regular tea bags. Tea made from decaffeinated tea bags averaged 5.7 mg per 6 oz and that from the regular tea bags averaged 42.0 mg. The range for decaffeinated teas was wide, from none to 21.5 mg per 6 oz, and that for the regular teas was 31.7 to 49.2. The sample of herb tea contained no caffeine.

The theobromine content of all teas was low, generally less than 4 mg per 6 oz. Tea made from regular tea bags averaged about 2.7 times the amount of theobromine as tea made from decaffeinated tea bags.

SUMMARY

The 121 regular and decaffeinated products tested for caffeine content included regular and decaffeinated coffee, tea, and sodas. Coffee made from decaffeinated ground coffee averaged 97.5% less caffeine per 6 oz serving than that made from regular ground coffee. Coffee made from decaffeinated instant coffee averaged 96% less caffeine per 6 oz than that made from regular instant coffee. Cola-type beverages with caffeine averaged 20 mg per 6 oz. Cola-type sodas claiming no caffeine contained none. Tea made from decaffeinated tea bags contained about 86% less caffeine per 6 oz than tea made from regular tea bags. Theobromine content in all teas was low, but tea made from regular tea bags contained about 2.7 times more theobromine than tea made from decaffeinated tea bags.

ACKNOWLEDGMENTS

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TABLE 1--CAFFEINE IN 6 OZ SERVING OF SOFT DRINKS AND COFFEE

Beverage/Brand	Label	Caffeine mg/serving
SOFT DRINK		
Cola-type		
Adirondack*	cherry, 99.9% caffeine free	0
C & C Free	99% caffeine free	0
Coca Cola Classic*		16.8
Coca Cola*		16.5
Diet Coke	caffeine free	0
Diet Coke*		23.0
Diet Rite Cola	caffeine free	0
Dr. Pepper*		25.3
Economy*	sugar free	0
Economy*		4.2
FresKola*		0
FresKola*		0
Jolt*	twice the caffeine	33.6
Mello-Yellow*		30.1
Mountain Dew*		28.3
Original New York Seltzer*	cola & berry flavor	0
Pepsi Cola*		18.1
Pepsi Free	caffeine free	0
Pepsi Light*	one calorie, sugar free	17.7
Pepsi Light*	one calorie, sugar free	18.2
Royal Crown RC Cola*		17.5
Royal Crown*	cherry	7.1
Slice*	cherry, new	0
Stop & Shop*		0
Stop & Shop*		0
Stop & Shop*		0
Stop & Shop*	sugar free	0
Stop & Shop*	sugar free	0
Tab	caffeine & sugar free	0
Tab*	sugar free	22.3
Weight Watchers	diet, 99.9% caffeine free	0
White Rock*		0
White Rock*		0
White Rock*	sugar free	0

TABLE 1--CAFFEINE IN 6 OZ SERVING OF SOFT DRINKS AND COFFEE (Continued)

Beverage/Brand	Label	Caffeine mg/serving
Non-cola type		
7-UP	no caffeine	0
Diet Sprite	caffeine free	0
FAW	contains coffee	56.6
Finast black cherry		0
Finast grape soda		0
Finast orange		0
Les Caf	iced tea	7.6
Ramblin Root Beer	caffeine free	0
Red Rose	iced tea	2.6
Sunkist Plus	new	0
Weight Watchers orange		0
COFFEE		
Ground, decaffeinated		
Brim	97% caffeine free	2.2
Brown Gold	97% caffeine free, all meth grind	0.8
Cafe Latino El Pico	97% caffeine free	0.8
Chock Full O' Nuts	98% caffeine free, all meth grind	1.2
Folgers	97% caffeine free, auto drip	2.1
Hills Bros.	auto drip	0.9
Martinson's	all meth grind	5.8
Maxwell House	97% caffeine free, percolator	2.7
Sanka	97% caffeine free, auto drip	2.0
Savarin	97% caffeine free, all meth grind	3.6
Shop Rite	97% caffeine free	1.1
Sweet Life	97% caffeine free	3.0
Ground, regular		
Chock Full O' Nuts	all method	104.9
El Pico Cafe Latino	extra fine grind	89.8
Finast	automatic drip	92.1
Folgers		82.8
French Market	coffee and chicory	22.7
Hills Bros.	regular grind	97.4
Martinson's	perculator	138.9
Maxwell House	Master Blend electra perk	76.6
Medaglio D'Oro	expresso	73.2
Melitta	extra fine grind	61.1
Savarin	automatic drip	97.8
Shop Rite	all purpose	101.3

TABLE 1--CAFFEINE IN SIX OZ SERVING OF SOFT DRINKS AND COFFEE (Continued)

Beverage/Brand	Label	Caffeine mg/serving
Instant, decaffeinated		
Folgers	97% caffeine free	1.7
High Point	97% caffeine free	1.7
Maxwell House	97% caffeine free	1.9
Nescafe	99.7% caffeine free	3.1
Sanka	97% caffeine free	2.8
Tasters Choice	Maragar Gold	2.1
Instant, regular		
Eight O'Clock		57.8
Finast		56.0
Folgers		64.0
Food Club		60.7
Kava		53.6
Maxwell House		22.9
Nescafe	Brava Bold & Dark	66.3
Shop Rite		62.6
Stop & Shop		62.6
Taster's Choice		56.6
Waldbaum's		54.9
Instant, special		
General Foods	orange cappuccino	59.8
General Foods	Suisse mocha	41.8

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* indicates that this beverage is labeled as a cola or contains caffeine or Kola nut extract

A value of 0 indicates less than 0.005 mg caffeine per 6 oz.

TABLE 2--CAFFEINE AND THEOBROMINE CONTENT IN 6 OZ SERVING OF TEA

Brand	Label	Caffeine	Theobromine
		mg/serving	
FRUIT TEA MIX			
Decaffeinated			
General Foods		0.5	0.03
Lipton	raspberry	1.8	0.2
ICED TEA MIX			
Decaffeinated			
Lipton		1.9	0.2
Lipton		2.2	0.2
Regular			
4C	no sugar, no saccharin	24.9	-*
4C		14.9	0.7
A & P Our Own		25.1	1.5
Finast		4.4	0.5
P & Q		16.6	1.5
TEA BAGS			
Decaffeinated			
Baker Street		19.7	0.5
Bigelow English Teatime		0.8	0.5
Bigelow Lemon Lift		0.5	0.5
Boston's	99 1/2% caffeine free	0	0
Celestial Seasonings	herb tea, caffeine free	0	0
Finast		1.0	0.6
Lipton		3.5	2.1
Lipton		5.2	2.2
Milford	caffeine free	0.8	0.4
Salada	naturally caffeine reduced	21.5	1.8
Tetley		5.5	1.0
Tetley		4.7	0.7
Regular			
A & P Our Own		38.6	1.9
Bigelow English Teatime		47.1	3.6
Bigelow Lemon Lift		42.7	2.6
Boston's Darteeling Blend		37.8	2.0
Lipton		45.9	2.6
Lipton		43.2	2.1
Red Rose		43.6	2.2
Salada		46.3	2.5
Salada		49.2	3.4
Stop & Shop		39.7	1.2
Tetley		38.3	2.0
Tetley		31.7	1.7

A value of 0 indicates less than 0.005 mg caffeine and less than 0.002 mg theobromine per 6 oz.

* indicates this product not tested for theobromine.

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